CLAIMS

I claim:

1. A method of forming a top-metal fuse structure, comprising the steps of:

providing a structure having an intermetal dielectric layer formed thereover; the structure including a fuse region and an RDL/bump/bonding pad region;

forming a composite metal layer over the intermetal dielectric layer; the composite metal layer including a second metal layer sandwiched between upper and lower first metal layers;

patterning the upper first metal layer to form an upper metal layer portion within the RDL/bump/bonding pad region; and

patterning the second metal layer and the lower first metal layer:

within the RDL/bump/bonding pad region to form an RDL/bump/bonding pad; the RDL/bump/bonding pad having a patterned second metal layer portion /lower first metal portion with a width greater than that of the upper metal layer portion and forming a step profile; and

within the fuse region to form the top-metal fuse structure.

2. The method of claim 1, wherein the structure is a substrate selected from the group consisting of a silicon substrate, a silicon-on-oxide substrate and a GaAs substrate.

3. The method of claim 1, wherein the intermetal dielectric layer is comprised of a material selected from the group consisting of: USG, PSG, BPSG, FSG and SiN; the second metal layer is comprised of a material selected from the group consisting of: TiN; Ti, TaN and Ta; and the upper and lower first metal layers are comprised of a material selected from the group consisting of: Al; an aluminum copper alloy; copper and a copper alloy.

4. The method of claim 1, wherein the intermetal dielectric layer is comprised of USG; the second metal layer is comprised of TiN; and the upper and lower first metal layers are comprised of Al.

5. The method of claim 1, wherein the intermetal dielectric layer has a thickness of from about 3000 to 15,000Å; the second metal layer has a thickness of from about 200 to 2000Å; the upper first metal layer have a thickness of greater than about 3000Å; and the lower first metal layer has a thickness of from about 2000 to 10,000Å.

6. The method of claim 1, wherein the second metal layer has a thickness of about 1000Å; the upper first metal layer have a thickness of greater than about 8000Å; and the lower first metal layer has a thickness of about 5000Å.

7. The method of claim 1, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers.

8. The method of claim 1, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers being comprised of a material selected from the group consisting of Ti, TiN, Ta and TaN.

9. The method of claim 1, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers being comprised of Ti.

10. The method of claim 1, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers each having a thickness of from about 30 to 300Å.

11. The method of claim 1, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers each having a thickness of about 100Å.

12. The method of claim 1, wherein the upper first metal layer is patterned using an etching process selected from the group consisting of: an RIE etch process; an RIE end-point detection etch process and a wet chemical etch process; and the second metal layer and the lower first metal layer are patterned using an etching process

selected from the group consisting of: an RIE etch process; an RIE end-point detection etch process and a wet chemical etch process.

13. The method of claim 1, wherein the upper first metal layer is patterned using an RIE end-point detection etching process; and the second metal layer and the lower first metal layer are patterned using an RIE end-point detection etching process.

14. The method of claim 1, wherein the upper first metal layer is patterned using an overlying patterned photoresist layer; and the second metal layer and the lower first metal layer are patterned using an overlying patterned photoresist layer.

15. The method of claim 1, wherein the RDL/bump/bonding pad is an RDL.

16. The method of claim 1, wherein the RDL/bump/bonding pad is a bump.

17. The method of claim 1, wherein the RDL/bump/bonding pad is a bonding pad.

18. The method of claim 1, wherein the structure is a silicon substrate.

19. The method of claim 1, wherein a barrier layer is formed over the intermetal dielectric layer.

20. The method of claim 1, wherein a barrier layer is formed over the intermetal dielectric layer; the barrier layer having a thickness of from about 100 to 800Å.

21. The method of claim 1, wherein a barrier layer is formed over the intermetal dielectric layer; the barrier layer being comprised of Ti/TiN or Ta/TaN.

22. A method of forming a top-metal fuse structure, comprising the steps of:

providing a substrate having an intermetal dielectric layer formed thereover; the substrate including a fuse region and an RDL/bump/bonding pad region; the substrate being comprised of a substrate selected from the group consisting of a silicon substrate, a silicon-on-oxide substrate and a GaAs substrate;

forming a composite metal layer over the intermetal dielectric layer; the composite metal layer including a second metal layer sandwiched between upper and lower first metal layers;

patterning the upper first metal layer to form an upper metal layer portion within the RDL/bump/bonding pad region; and

patterning the second metal layer and the lower first metal layer:

within the RDL/bump/bonding pad region to form an RDL/bump/bonding pad; the RDL/bump/bonding pad having a patterned second metal layer portion/lower first metal portion with a width greater than that of the upper metal layer portion and forming a step profile; and

within the fuse region to form the top-metal fuse structure.

23. The method of claim 22, wherein the intermetal dielectric layer is comprised of a material selected from the group consisting of: USG, PSG, BPSG, FSG and SiN; the

second metal layer is comprised of a material selected from the group consisting of: TiN; Ti, TaN and Ta; and the upper and lower first metal layers are comprised of a material selected from the group consisting of: Al; an aluminum copper alloy; copper and a copper alloy.

24. The method of claim 22, wherein the intermetal dielectric layer is comprised of USG; the second metal layer is comprised of TiN; and the upper and lower first metal layers are comprised of Al.

25. The method of claim 22, wherein the intermetal dielectric layer has a thickness of from about 3000 to 15,000Å; the second metal layer has a thickness of from about 200 to 2000Å; the upper first metal layer have a thickness of greater than about 3000Å; and the lower first metal layer has a thickness of from about 2000 to 10,000Å.

26. The method of claim 22, wherein the second metal layer has a thickness of about 1000Å; the upper first metal layer have a thickness of greater than about 8000Å; and the lower first metal layer has a thickness of about 5000Å.

27. The method of claim 22, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers.

28. The method of claim 22, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers being comprised of a material selected from the group consisting of Ti, TiN, Ta and TaN.

29. The method of claim 22, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers being comprised of Ti.

30. The method of claim 22, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers each having a thickness of from about 30 to 300Å.

31. The method of claim 22, wherein the composite metal layer further includes third metal layers interposed between the second metal layer and the respective lower and upper first metal layers; the third metal layers each having a thickness of about 100Å.

32. The method of claim 22, wherein the upper first metal layer is patterned using an etching process selected from the group consisting of: an RIE etch process; an RIE end-point detection etch process and a wet chemical etch process; and the second metal layer and the lower first metal layer are patterned using an etching

process selected from the group consisting of: an RIE etch process; an RIE end-point detection etch process and a wet chemical etch process.

33. The method of claim 22, wherein the upper first metal layer is patterned using an RIE end-point detection etching process; and the second metal layer and the lower first metal layer are patterned using an RIE end-point detection etching process.

34. The method of claim 22, wherein the upper first metal layer is patterned using an overlying patterned photoresist layer; and the second metal layer and the lower first metal layer are patterned using an overlying patterned photoresist layer.

35. The method of claim 22, wherein the RDL/bump/bonding pad is an RDL.

36. The method of claim 22, wherein the RDL/bump/bonding pad is a bump.

37. The method of claim 22, wherein the RDL/bump/bonding pad is a bonding pad.

38. The method of claim 22, wherein the substrate is a silicon substrate.

39. The method of claim 22, wherein a barrier layer is formed over the intermetal dielectric layer.

40. The method of claim 22, wherein a barrier layer is formed over the intermetal dielectric layer; the barrier layer having a thickness of from about 100 to 800Å.

41. The method of claim 22, wherein a barrier layer is formed over the intermetal dielectric layer; the barrier layer being comprised of Ti/TiN or Ta/TaN.

42. A top-metal fuse structure and an RDL/bump/bonding pad structure, comprising:

a structure having an overlying intermetal dielectric layer; the structure including a fuse region and an RDL/bump/bonding pad region;

a top-metal fuse structure over the intermetal dielectric layer within the fuse region; the top-metal fuse structure having:

a patterned lower first metal layer fuse portion over the intermetal dielectric layer; and

a patterned second metal layer fuse portion centered over the lower first metal layer fuse portion; the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion each having equal widths;

and

an RDL/bump/bonding pad structure over the intermetal dielectric layer within the RDL/bump/bonding region; the RDL/bump/bonding pad structure having:

a patterned lower first metal layer non-fuse portion over the intermetal dielectric layer, the patterned lower first metal layer non-fuse portion having a first width;

a patterned second metal layer non-fuse portion centered over the lower first metal layer non-fuse portion, the patterned second metal layer non-fuse portion having a second lower width equal to the first width of the patterned lower first metal layer non-fuse portion and a second upper width less than the first width of the patterned lower first metal layer non-fuse portion; and

a patterned upper first metal layer non-fuse portion centered over the patterned second metal layer non-fuse portion, the patterned upper first metal layer non-fuse portion having a third width less than the second lower width of the patterned second metal layer non-fuse portion whereby a step profile is formed at least as between the patterned upper first metal layer non-fuse portion and the patterned second metal layer lower width non-fuse portion.

43. The method of claim 42, wherein the structure is a structure is a substrate selected from the group consisting of a silicon substrate, a silicon-on-oxide substrate and a GaAs substrate.

44. The method of claim 42, wherein the intermetal dielectric layer is comprised of a material selected from the group consisting of: USG, PSG, BPSG, FSG and SiN; the second metal layer is comprised of a material selected from the group consisting of: TiN; Ti, TaN and Ta; and the upper and lower first metal layers are comprised of a material selected from the group consisting of: Al; an aluminum copper alloy; copper and a copper alloy.

45. The method of claim 42, wherein the intermetal dielectric layer is comprised of USG; the second metal layer is comprised of TiN; and the upper and lower first metal layers are comprised of Al.

46. The method of claim 42, wherein the intermetal dielectric layer has a thickness of from about 3000 to 15,000Å; the second metal layer has a thickness of from about 200 to 2000Å; the upper first metal layer have a thickness of greater than about 3000Å; and the lower first metal layer has a thickness of from about 2000 to 10,000Å.

47. The method of claim 42, wherein the second metal layer has a thickness of about 1000Å; the upper first metal layer have a thickness of greater than about 8000Å; and the lower first metal layer has a thickness of about 5000Å.

48. The method of claim 42, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion.

49. The method of claim 42, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion being comprised of a material selected from the group consisting of Ti, TiN, Ta and TaN.

50. The method of claim 42, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion being comprised of Ti.

51. The method of claim 42, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion has a thickness of from about 30 to 300Å.

52. The method of claim 42, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion has a thickness of about 100Å.

53. The method of claim 42, wherein the RDL/bump/bonding pad structure is an RDL.

54. The method of claim 42, wherein the RDL/bump/bonding pad structure is a bump.

55. The method of claim 42, wherein the RDL/bump/bonding pad structure is a bonding pad.

56. The method of claim 42, wherein the structure is a silicon substrate.

57. The method of claim 42, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer.

58. The method of claim 42, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer; the barrier layer having a thickness of from about 100 to 800Å.

59. The method of claim 42, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer; the barrier layer being comprised of Ti/TiN or Ta/TaN.

60. A top-metal fuse structure and an RDL/bump/bonding pad structure, comprising:

a substrate having an overlying intermetal dielectric layer; the substrate including a fuse region and an RDL/bump/bonding pad region; the substrate

being comprised of a substrate selected from the group consisting of: a silicon substrate, a silicon-on-oxide substrate and a GaAs substrate;

a top-metal fuse structure over the intermetal dielectric layer within the fuse region; the top-metal fuse structure having:

a patterned lower first metal layer fuse portion over the intermetal dielectric layer; and

a patterned second metal layer fuse portion centered over the lower first metal layer fuse portion; the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion each having equal widths;

and

an RDL/bump/bonding pad structure over the intermetal dielectric layer within the RDL/bump/bonding region; the RDL/bump/bonding pad structure having:

a patterned lower first metal layer non-fuse portion over the intermetal dielectric layer, the patterned lower first metal layer non-fuse portion having a first width;

a patterned second metal layer non-fuse portion centered over the lower first metal layer non-fuse portion, the patterned second metal layer non-fuse portion having:

a second lower width equal to the first width of the patterned lower first metal layer non-fuse portion; and

a second upper width less than the first width of the patterned lower first metal layer non-fuse portion; and

a patterned upper first metal layer non-fuse portion centered over the patterned second metal layer non-fuse portion, the patterned upper first metal layer non-fuse portion having a third width less than the second lower width of the patterned second metal layer non-fuse portion whereby a step profile is formed at least as between the patterned upper first metal layer non-fuse portion and the patterned second metal layer lower width non-fuse portion.

61. The method of claim 60, wherein the intermetal dielectric layer is comprised of a material selected from the group consisting of: USG, PSG, BPSG, FSG and SiN; the second metal layer is comprised of a material selected from the group consisting of: TiN; Ti, TaN and Ta; and the upper and lower first metal layers are comprised of a material selected from the group consisting of: Al; an aluminum copper alloy; copper and a copper alloy.

62. The method of claim 60, wherein the intermetal dielectric layer is comprised of USG; the second metal layer is comprised of TiN; and the upper and lower first metal layers are comprised of Al.

63. The method of claim 60, wherein the intermetal dielectric layer has a thickness of from about 3000 to 15,000Å; the second metal layer has a thickness of from about 200 to 2000Å; the upper first metal layer have a thickness of greater than about 3000Å; and the lower first metal layer has a thickness of from about 2000 to 10,000Å.

64. The method of claim 60, wherein the second metal layer has a thickness of about 1000Å; the upper first metal layer have a thickness of greater than about 8000Å; and the lower first metal layer has a thickness of about 5000Å.

65. The method of claim 60, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion.

66. The method of claim 60, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion being comprised of a material selected from the group consisting of Ti, TiN, Ta and TaN.

67. The method of claim 60, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion being comprised of Ti.

68. The method of claim 60, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion has a thickness of from about 30 to 300Å.

69. The method of claim 60, wherein the top-metal fuse structure further includes a third metal layer fuse portion interposed between the patterned lower first metal layer fuse portion and the patterned second metal layer fuse portion; the third metal layer fuse portion has a thickness of about 100Å.

70. The method of claim 60, wherein the RDL/bump/bonding pad structure is an RDL.

71. The method of claim 60, wherein the RDL/bump/bonding pad structure is a bump.

72. The method of claim 60, wherein the RDL/bump/bonding pad structure is a bonding pad.

73. The method of claim 60, wherein the substrate is a silicon substrate.

74. The method of claim 60, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer.

75. The method of claim 60, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer; the barrier layer having a thickness of from about 100 to 800Å.

76. The method of claim 60, wherein the structure further includes a barrier layer overlying the intermetal dielectric layer; the barrier layer being comprised of Ti/TiN or Ta/TaN.